
Space Weather Technical Forecast

Issued on Sunday, 05 June 2022 at 13:18 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Active Electron Fluence. Chance of G1-G2/Minor to Moderate Storm intervals late Day 1 or Day 2 (5th-6th) from possible CME arrival(s).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Very Low, with only B-class flares observed during the past 24 hours. There are five numbered sunspot regions presently on the visible disc. A sixth region did develop in the northeast quadrant for a time but has subsequently faded back to plage. All regions currently on the disc are small and simple and have shown no significant signs of development. No other Earth-directed CMEs were observed in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, has been at ambient levels through the period, and largely below 300 km/s. Density has been mostly average (5-10 ppcc), but rose slightly above average from 05/0940 UTC. The total interplanetary magnetic field strength, Bt, has been weak between 3 and 6 nT, with the north-south component, Bz, varying weakly between +/- 4nT. Phi angle was predominantly negative (towards the Sun), but with a positive (away from the Sun) spell observed 05/1900-2300 UTC. Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at background levels. The high energy electron flux (greater than 2 MeV) has generally been at High levels, reaching a peak of 9520 pfu at 04/1655 UTC. Electron fluence has been above the Active threshold throughout, reaching 5.22e8 integrated pfu at 05/0000UTC.

Four-Day Space Weather Forecast Summary

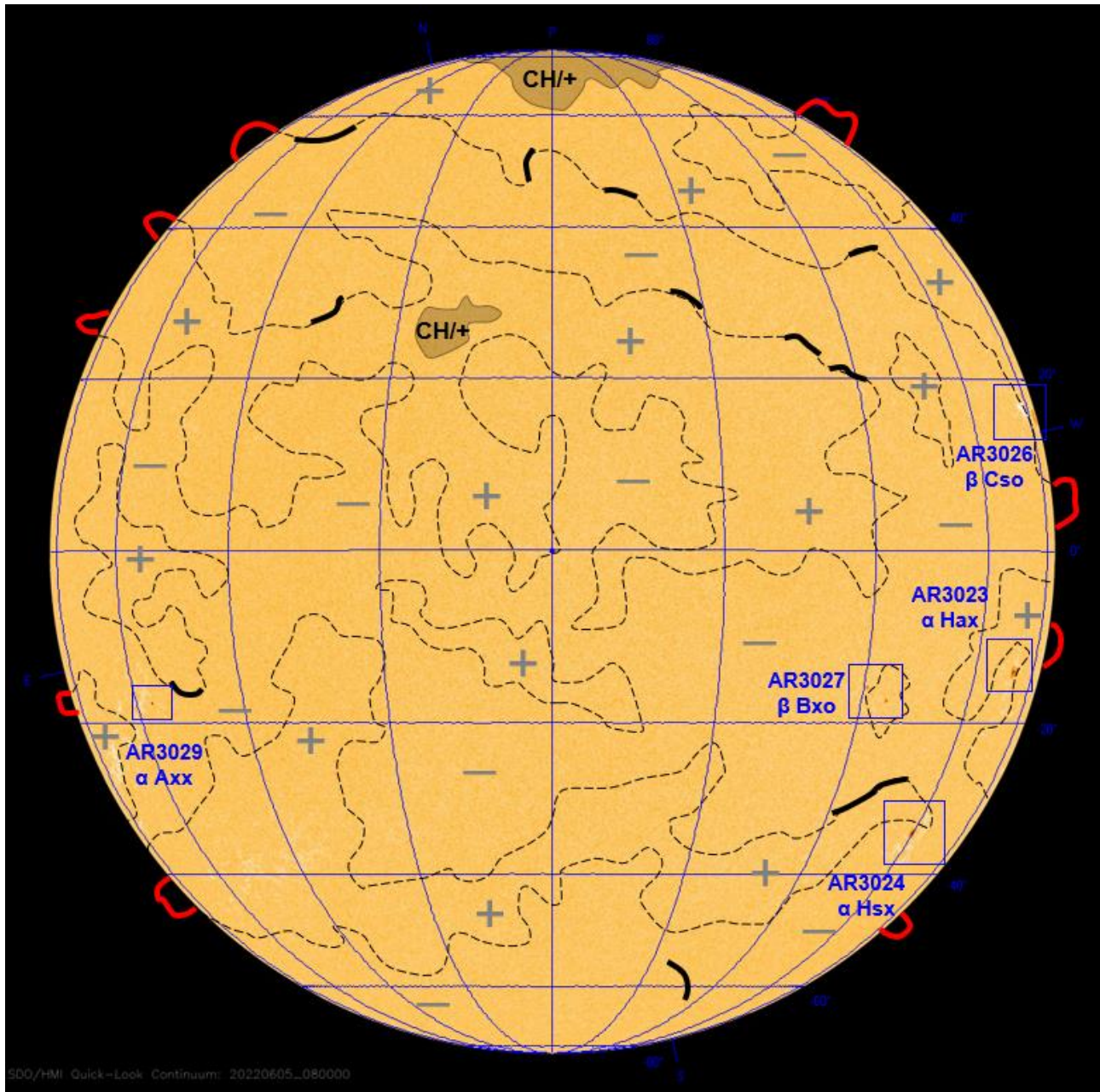
Solar Activity: Solar activity is expected to be Low to Very Low, with a chance of C-class flares.

Solar Wind / Geomagnetic Activity: There are three potentially Earth-directed CMEs, although all are low confidence. The first two are from filament eruptions that occurred around 01/0100 UTC and 02/0530 UTC and are expected to pass 05/1800+/-12 hours, and 06/0000 +/-12 hours. The first is very weak, but more Earth-directed, with the second slightly faster but likely to give only a glancing impact. However, these could also potentially combine to give a single arrival. The third, is the filament eruption around 04/0300 UTC, and is expected to miss, but with a low chance of glancing impact late on day 3 (7th) or early day 4 (8th). Otherwise no other solar wind enhancements are indicated, with mainly ambient winds expected. Geomagnetic activity is forecast to be predominately Quiet, but increasing to Unsettled to Active should any CME arrivals occur. These will also give a chance of isolated G1-G2 Minor to Moderate storms.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10 MeV) is expected to be at background levels during this period. High energy electron flux (greater than 2MeV) is expected to be at High levels at first, before likely dropping out with any CME arrival later day 1 or day 2 (5th or 6th). Some recovery in values is possible days 3-4 (7th-8th), potentially to high, however this is low confidence. The associated 24 hour fluence is expected to persist at Active (above 1e8 integrated pfu), but potentially falling below later day 2 or day 3 (6th-7th) in response to any dropout that occurs from any CME arrivals, and otherwise with a gradually decreasing trend.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

Figure 1. Solar Analysis Valid 05/0800 UTC.



Key: Filament —, Prominence —, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - γ - δ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

A filament lift-off was observed from the centre disc around 01/0100 UTC, with an associated coronal dimming. A weak CME was produced, which has been assessed as a slow CME, giving a slight chance of a glancing blow late day 1, around 05/1800UTC +/- 12 hours. A further filament eruption sourced CME was also observed leaving the southwest disc around 02/0530 UTC. This has the potential for a glancing blow around 06/0000 UTC +/- 12hours. Both CMEs are low confidence, however there is also the potential for a combined arrival, perhaps increasing the strength of any a geomagnetic response, most likely with any magnetic cloud moving through on the 6th.

A further, third CME was observed leaving the northeast disc due to a filament eruption around 04/0300 UTC. This is missing north and behind Earth, however a glancing influence isn't impossible late on the 7th (day 3) or early 8th (day 4).

Aside from the CMEs, background wind speeds are expected to persist through the period with no notable coronal hole fast wind enhancements expected.

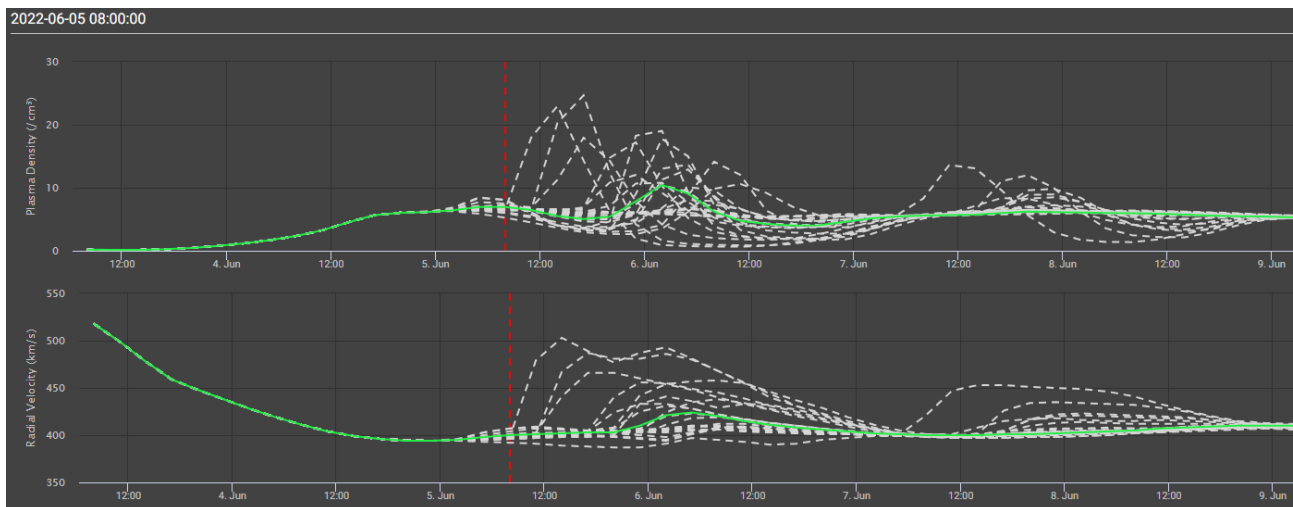
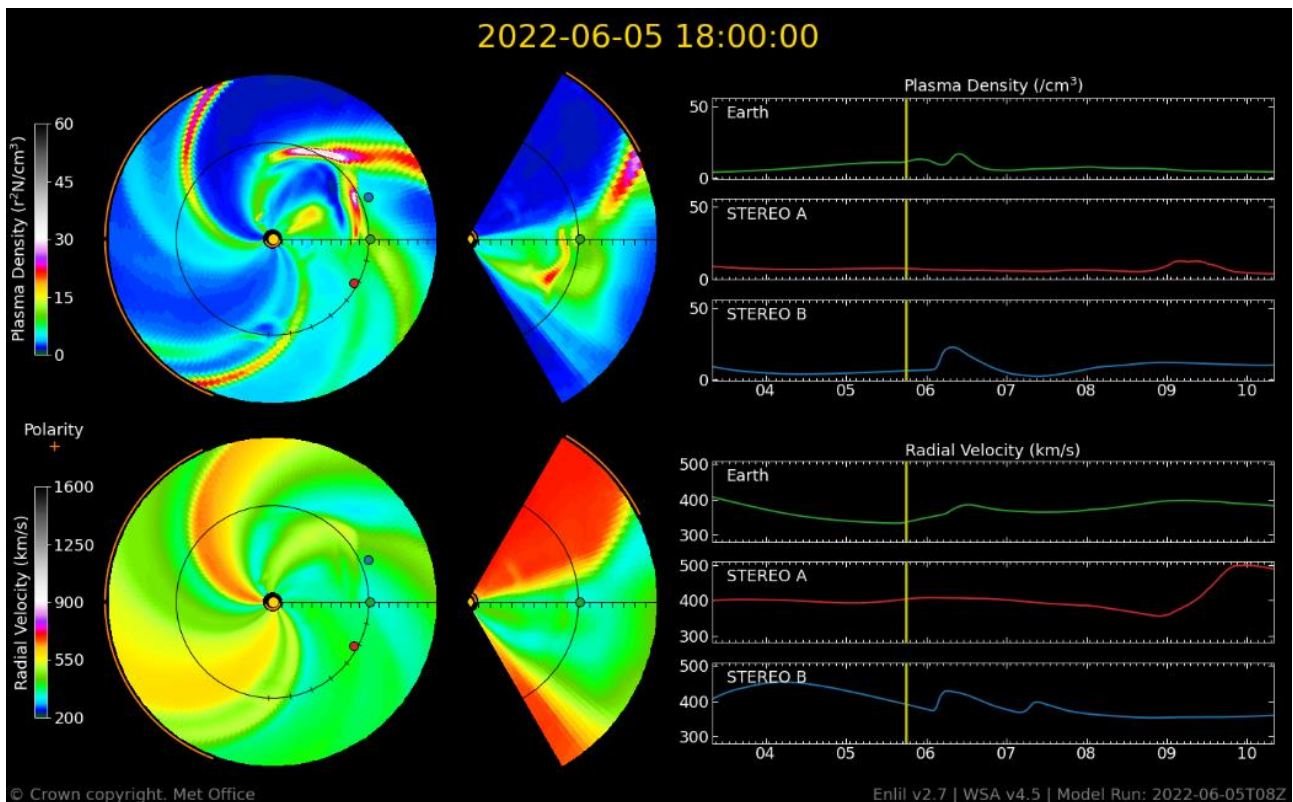
Geomagnetic activity is forecast to be predominately Quiet, but perhaps increasing to Unsettled to Active for a time late day 1 and during day 2 (5th and 6th) should any CME arrival occur. These will also give a chance of isolated G1-G2 Minor to Moderate storms. There is a very slight chance of similar enhanced geomagnetic activity day 3/4 (7th/8th) with the third CME, but otherwise activity is expected to ease back to predominantly Quiet conditions.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	20	30	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
01/1300	Partial	Filament Eruption	4N 10W	252 km/s	05/1800 +/- 12 hours	Limited shock. Weak
02/1315	Partial	Filament Eruption	6S 45W	525 km/s	06/0000 +/- 12 hours	Glancing impact possible
04/1032	Partial	Filament Eruption	32N 30E	620 km/s	Missing	Glancing blow possible 7 th /8 th

Figure 2: ENLIL including ensemble



Radio Blackouts - X-Ray Flares:

There are presently five numbered sunspot regions on the visible disc, although all of these are currently small and simple, and are either stable or showing signs of decay. The regions with the largest flare risk (AR3023 (Hax / Alpha) and AR3026 (Cso / Beta)) will transit round the west limb over the next couple of days, however a bright region visible near the southeast limb on STEREO-A EUVI 195 imagery is likely to rotate on to the Earth facing disc on day 4 (8th).

Very Low solar activity is expected to continue through the forecast period, but there is a chance of it increasing to Low levels, with isolated C-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	2	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is at background levels and is expected to remain at this level through the period.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm⁻²sr⁻¹s⁻¹)

High Energy Electrons Event ($\geq 2\text{MeV}$):

The high energy electron flux (greater than 2MeV) as observed by GOES-16 has been at High (greater than 1000pfu) levels through the last 24 hours due to the fast wind enhancement that occurred a few days ago. These mainly High levels are expected to persist until the potential arrival of two CMEs late day 1 or day 2 (5th or 6th), which are likely to cause levels to drop out, before a recovery to Moderate to High levels day 3 and 4 (7-8th).

The associated 24 hour electron fluence is currently Active (greater than $1\text{e}8$ integrated pfu) and is expected to persist at this level into day 2 (6th). Confidence then falls for continuing Active levels into day 3 and 4 (7th-8th), due to the potential drop out of flux that occurs, along with an uncertain recovery following. Observed fluence is currently running much higher than REFM expectations, and consequently expected to remain well above the REFM forecast.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	Yes	100	90	30	30
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 3: GOES-16 $>2\text{MeV}$ electron flux and fluence with REFM data.

